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The American Biology Teacher

MAY, 1956 VOL. 18, No. 5

The Small Stream

School Homesteading

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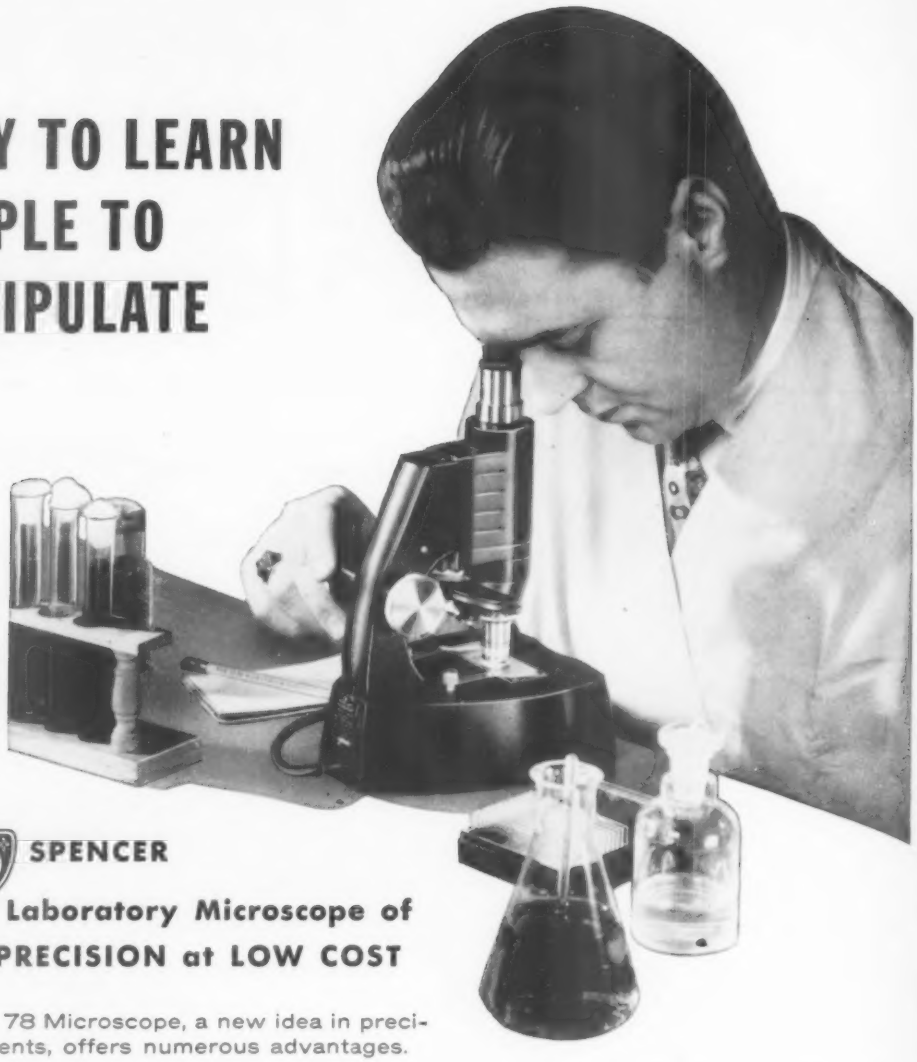

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Teachers and Students Invited

Teachers and students are invited to send in photographs to be used on the cover of future issues of THE AMERICAN BIOLOGY TEACHER. Please enclose brief description along with each picture.

Cover Photograph

Chipmunk. — Photograph by John Stemen, Goshen, Indiana, who is field auditor for the State of Indiana and enjoys nature photography as an avocation.

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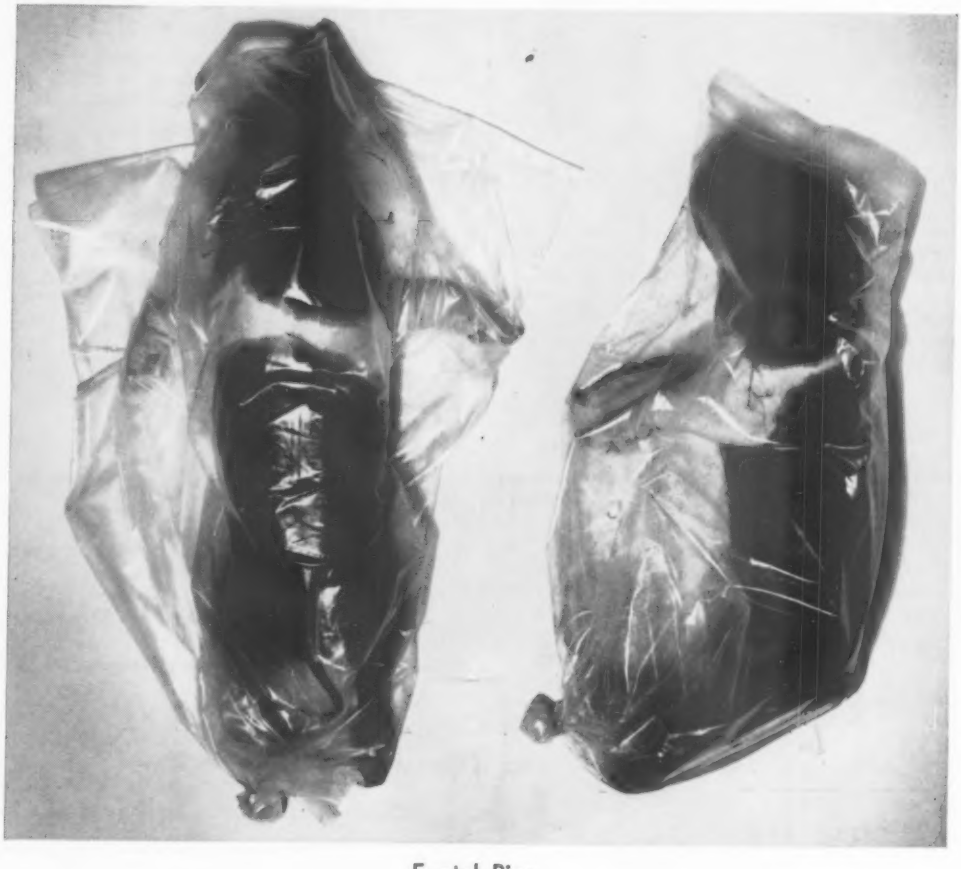

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The Small Stream as a Laboratory Project: *Bottom Fauna*[1]

ANDREAS A. PALOUMPIS and KENNETH D. CARLANDER
Department of Zoology and Entomology
Iowa State College, Ames

A. *Introduction*

A small stream located near the school can serve effectively as a "laboratory" in the study of the biological sciences. Most schools have one or more small streams within relatively easy access.

Students can usually recognize more quickly the adaptations which aquatic animals have than the adaptations of the more familiar terrestrial animals. Study of aquatic animals is thus a particularly effective method of teaching ecology or the relationship of animals to their environment. The study of a small stream can assist the instructor in teaching about animal communities, soil erosion and pollution.

It is not possible to deal with all phases of stream life in one article, and therefore, this article discusses only the animals that live in or on the bottom of a stream.

B. *Material and Methods*

Very little special equipment is needed to study the bottom fauna of streams. Many of the organisms may be collected and observed by merely picking up stones from the stream bottom. A pair of forceps is of great help in picking animals from the rocks because many of the animals are small and flattened against the rock surface or in crevices where they cannot be picked out with the fingers. The animals can then be placed into a pan, glass jar, or aquarium for observation. Closer examination under a hand lens or the lower power of a microscope is often desirable. An hour's collection from the stream bottom can easily provide material for three or four hours' profitable study in the laboratory.

More can be learned about the relationship of the aquatic animals to their environment if quantitative methods of collection are used. Then the numbers and kinds of organisms on one type of stream bottom can be compared with the numbers and kinds on another stream bottom. Or the life in pools can be compared with that on riffle areas. The "productivity" of areas can be evaluated. Equipment for quantitative collection can be very easily accumulated and made.

The important feature in quantitative collections is the capture of all organisms from a measured area of bottom. A simple, efficient sampler can be made with a section of stove pipe. The stove pipe is pressed into the stream bottom thereby measuring the area. The sand, mud and water inside the stove pipe are then dipped out with a tin can or cup and placed in a pan so that the bottom organisms can be picked out. Only the top 3 inches of the stream bottom need to be taken since few organisms burrow that far. The mud and fine sand can be separated from the rest of the sample before picking the organisms by sifting the sample in a box with fine screen on the bottom. Brass screen with 30 meshes to the inch is usually used in research investigations. A larger mesh, such as copper window screen, will catch the larger animals and permit more rapid examination of the sample.

Quantitative sampling of rocky bottoms is more difficult. A satisfactory sampler can be made from two metal frames, each one foot square, hinged so that they are at right angles to each other. The vertical frame has a bag net of 000 XXX bolting silk or of fine mesh nylon netting. Canvas or muslin is stretched on each side across the angle formed by the two frames to prevent organisms from washing out rather than through the net. The sampler is placed with one frame marking off one square foot of stream bottom and with the other frame and net on the downstream edge.

[1]From Project 38 of Iowa Cooperative Fisheries Research Unit sponsored by the Iowa State Conservation Commission and the Industrial Science Research Institute of Iowa State College.

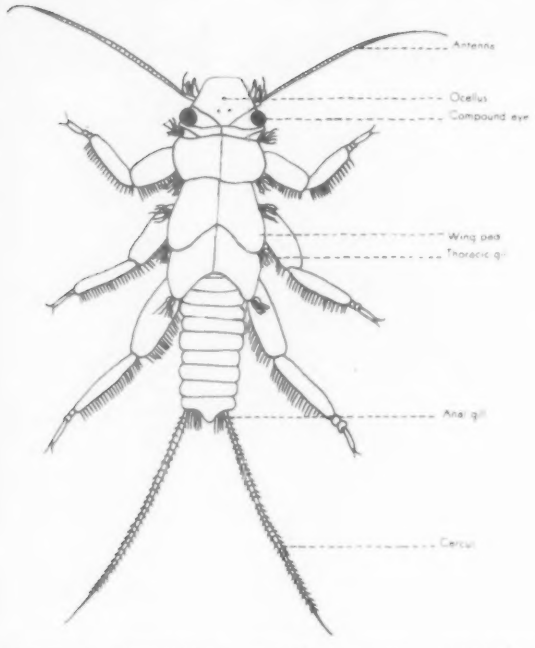

FIGURE 1. Generalized stonefly nymph. (Modified from Pennak, 1953).

The rocks within the sample area are then scrubbed (an ordinary kitchen scrub brush works well) under water so that the organisms wash into the net. The other materials within the sampling area are also stirred up to a depth of three inches. This sampler can be used only in shallow, flowing water, but it picks up many forms which might otherwise be missed.

If many quantitative samples are collected for comparative studies, the screened materials or the picked organisms may be placed in jars and preserved with 1 part of concentrated formalin to 9 parts of water.

At least three types of analysis are desirable in comparing the fauna of different areas. First, the various kinds of organisms in each habitat should be listed. Second, the number of organisms of each kind per square foot-sample should be determined. Some habitats have only a few species of animals but large numbers of individuals. Since the organisms vary greatly in size, a third analysis is necessary if the "productivity" of areas is to be compared. A simple method is to determine the volume of the organisms found per square foot sample. A graduate is half-filled with water and the volume of the water recorded. The organisms from a sample are then placed

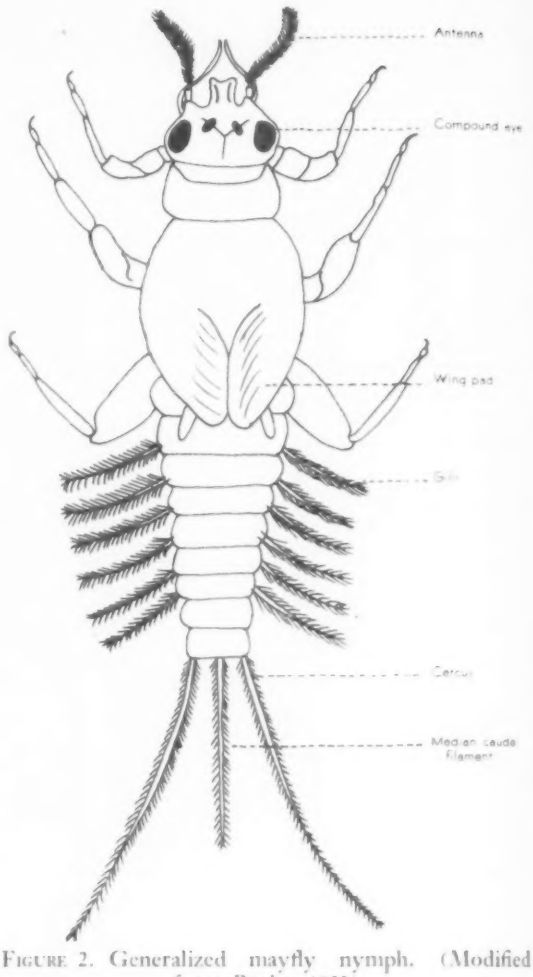

FIGURE 2. Generalized mayfly nymph. (Modified from Burks, 1953).

on a paper towel for about one minute and then dropped into the graduate. The increased volume in the graduate is equal to the volume of the organisms. A graduated centrifuge tube gives more accurate measurements than a larger graduated cylinder if the total volume of the organisms is small.

In trout stream investigations, less than 1 cubic centimeter of organisms per square foot sample is taken to represent an unproductive area. Over 2 cubic centimeters per square foot usually means good production of trout food.

C. *Principal Bottom Organisms and their Habitat Preference*

The types of organisms which inhabit stream bottoms are many and varied and not all forms will be found in any one habitat type.

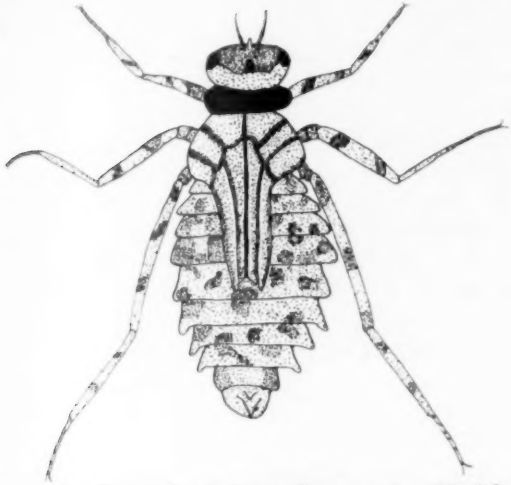

FIGURE 3. Generalized dragonfly nymph. (Modified from Pennak, 1953).

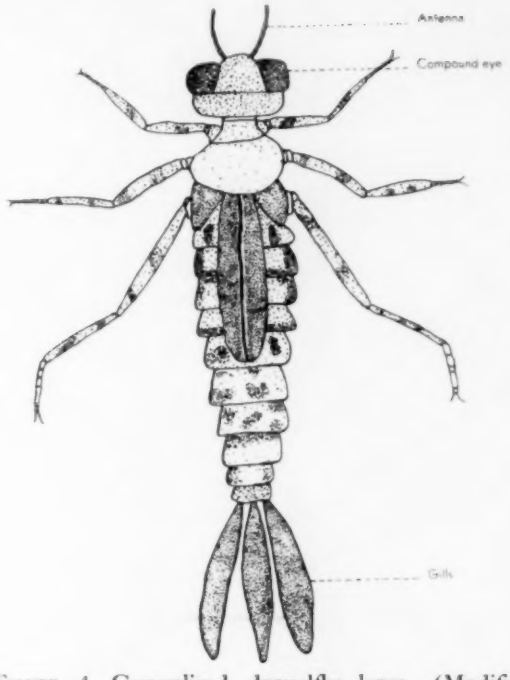

FIGURE 4. Generalized damselfly larva. (Modified from Pennak, 1953).

Aquatic earthworms tend to be found on muddy bottoms which are rich in organic materials. The aquatic earthworms feed on the organic materials contained in the bottom muds. Certain species are very tolerant to depletions of oxygen and are often one of the few species found in areas polluted by sewage.

Leeches may be scavengers, parasites or predators. Predatory leeches that feed on worms, clams and insect larvae are more apt to be taken in a bottom sample than are the other forms. Occasionally a blood sucking form may accidentally appear in a bottom sample.

Stonefly larvae (Fig. 1) are usually found under stones or debris in rivers, small streams and ponds. A few forms are carnivorous and feed on other aquatic insects, but the majority feed on algae and plant material.

Mayfly nymphs (Fig. 2) are found in a variety of habitats. Some prefer quiet waters with all types of bottoms and others prefer running water. They are almost entirely herbivorous in their feeding habits. The body form of some that live on rocks is very streamlined; others are modified for burrowing.

Dragonfly larvae (Fig. 3) and damselfly larvae (Fig. 4) may also be found in a variety of habitats. They are carnivorous, feeding on aquatic insects, worms, molluscs and small crustaceans.

Waterboatmen and backswimmers are found on muddy bottoms where the movement of water is imperceptible. They feed on debris, protozoans and algae. These forms are not typically bottom dwellers and their appearance in bottom samples is usually due to large concentrations in the area.

Helgrammite larvae (Fig. 5) are usually found between and under stones in a stream. They are predacious in their feeding habits and feed largely on other aquatic insects. The larvae are a favorite bait of many bass fishermen. The adults are known as Dobson flies and are also commonly referred to as "fish-flies."

Caddisfly larvae (Figs. 6 and 7) build cases of stones, sticks, and snailshells and are found in varied habitats. In swift moving streams the cases are often attached to rocks. Some are carnivorous, feeding on insect larvae, worms and crustaceans, whereas, others feed on plankton.

The beetles are a large and varied group and any discussion concerning the habitat preference of the different aquatic larval forms would require more time and space than is possible in this paper.

The immature stages of the Diptera are to be found in every type of aquatic habitat. Many families have aquatic stages but only the

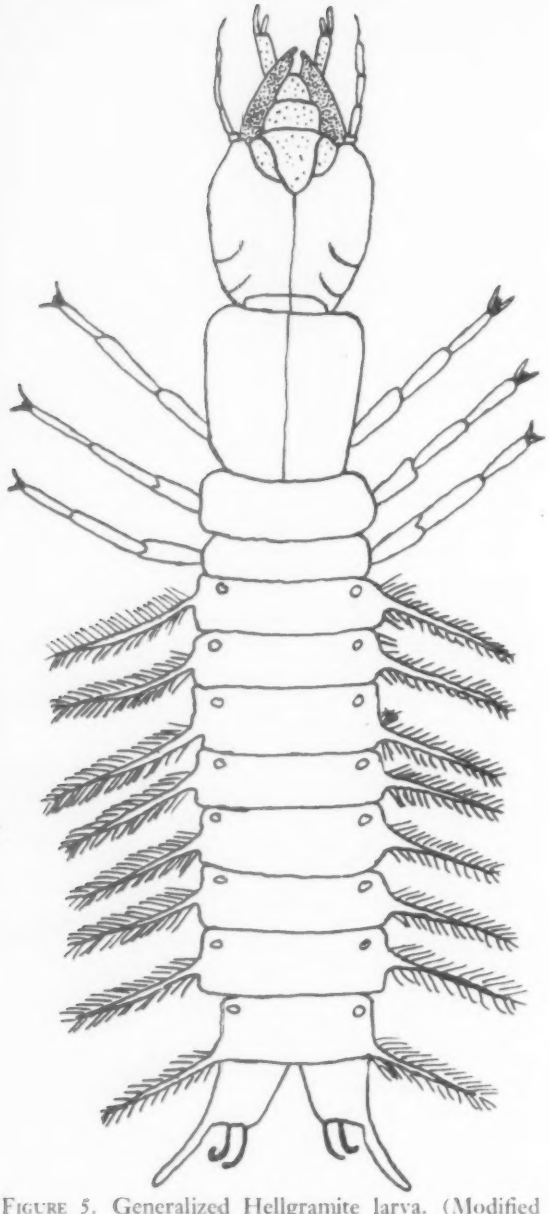

FIGURE 5. Generalized Hellgramite larva. (Modified from Peterson, 1951).

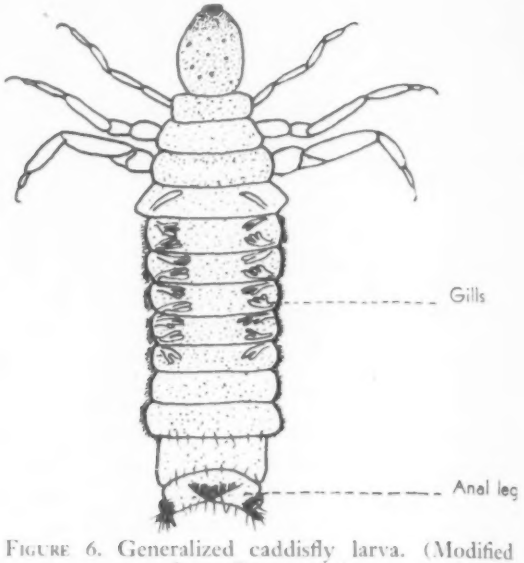

FIGURE 6. Generalized caddisfly larva. (Modified from Ross, 1944).

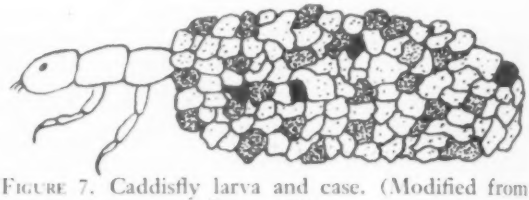

FIGURE 7. Caddisfly larva and case. (Modified from Ross, 1944).

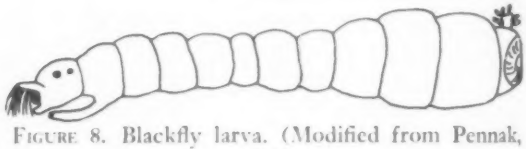

FIGURE 8. Blackfly larva. (Modified from Pennak, 1953).

black flies, true midges, biting midges and the phantom midge larvae will be discussed.

The larvae of the black flies (Fig. 8) are usually found on rocks or boards in swiftly flowing water. They may be so numerous as to make rocks slippery. The food of the larvae consists chiefly of algae.

The true midges (Fig. 9) are found on the bottoms of all types of fresh water. They are herbivorous in their feeding habits, feeding largely on algae and organic detritus. Certain species of the true midges are also tolerant to depletions of oxygen and are used as indicators of pollution. The species which are tolerant to pollution are referred to as "blood worms" because of their red coloration. This red color is due to the presence of a compound similar to hemoglobin in the body fluid.

The biting midges (Fig. 10) are found in diverse habitats. Their feeding habits are also varied, some being carnivorous, some herbivorous and some cannabalistic.

The phantom midge larvae are not ordinarily found in streams but usually inhabit ponds and lakes. These forms are predatory, feeding on crustaceans and insect larvae. They are called phantom midge larvae because they are so transparent that they are very difficult

to see. They move through the water by jerky movements.

Forms such as the crayfish are also present on the bottoms of streams but are usually not taken by a bottom sample. They are usually frightened away by the approaching sampler.

Gammarus, a smaller crustacean, commonly called a scud, is found in unpolluted clear water. It is usually found in vegetation or under stones and debris.

Molluscs are found in all types of aquatic habitats. Snails feed mainly on plant material, whereas, clams feed on plankton and detritus.

D. *Discussion*

Many fish are bottom feeders and rely upon the presence of the bottom organisms as their source of food. Any condition which would tend to eliminate the bottom organisms would also affect the distribution of the fish.

In a small stream high waters may cause the shifting of large quantities of mud and sand. This shifting of the stream bottom may cause productive areas to be covered by sand, thereby eliminating the available fish food organisms.

Pollution of a stream also affects the bottom fauna of the stream adversely. Silt and sewage are two of the most important forms of pollution.

Settling silt tends to cover the bottom organisms and clog their breathing apparatus. The soft flocculent layer of silt will often times not support some of the larger bottom organisms (large snails and clams).

The problem of sewage pollution has increased with our increasing population. A small amount of sewage acts as a fertilizer making the bottom deposits more productive. As the amount of sewage increases the action of the decomposition bacteria on the sewage use more and more oxygen until the dissolved oxygen content of the water is lowered. The only bottom forms that can exist in this type of situation are the sludge worms (certain aquatic earthworms with long bristles) and "blood worms."

The presence of these two forms in a stream with other bottom organisms does not indicate pollution, but their presence in high numbers and the absence of other forms does. The absence of a certain form in a stream may not be due to the presence of pollution but to the ecological requirements of the form.

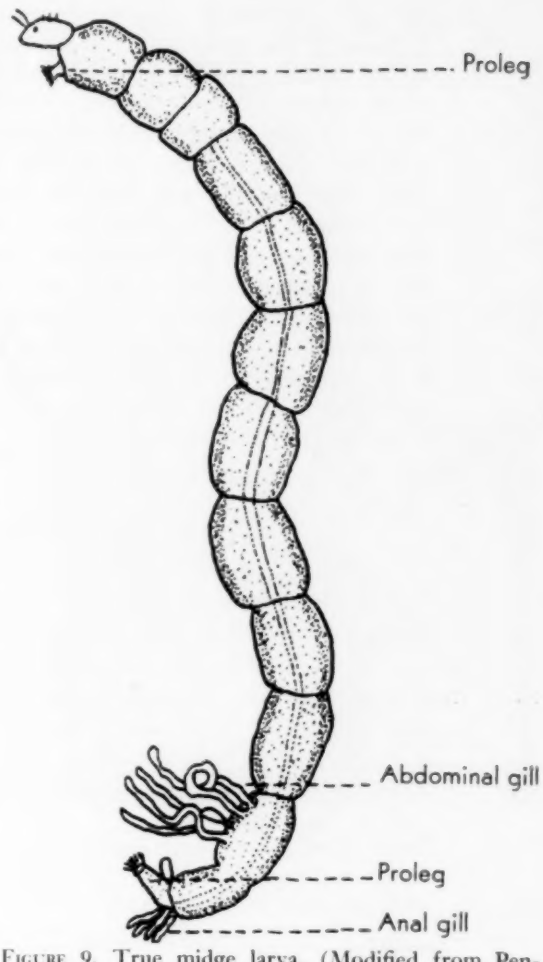

FIGURE 9. True midge larva. (Modified from Pennak, 1953).

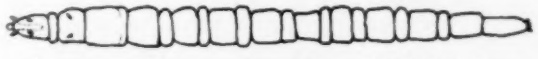

FIGURE 10. Biting midge larva. (Modified from Peterson, 1951).

E. *Suggested Projects*

1. Observations on the behavior of bottom fauna organisms.
   a. Place various animals in a pan or aquarium, with a few rocks or vegetation, and observe their methods of locomotion. Snails, caddisflies with their cases, crayfish (retreat backwards when startled), Gammarus (swim on their sides part of the time), backswimmers, and burrowing mayfly numphs. Which try to hide under rocks or in darker portions of the aquarium?

b. Set up a current by placing the pan just under the surface in the stream or by swirling the water with your hand. Most stream organisms will head into the current. If they were normally carried along by the current, they would not live in the stream long.

c. The feeding and respiratory activities of many of these animals set up small currents. These currents can be observed in a quiet pan by adding a small amount of finely powdered dye, such as neutral red or a drop of India ink, near the organism.

2. Study of methods of getting oxygen for respiration.
   a. Some beetles carry a film of air around their bodies, held in place by the elytra, legs or hairs.
   b. Many insect nymphs have external gills. Notice the gills on the abdomen of mayflies and the manner in which they are moved to keep a current of fresh water around them. Damselfly nymphs have plate-like gills on the end of the abdomen.
   c. Some snails have gills—others have lungs and most come to the surface at intervals.
3. Comparison of pool and riffle communities.
   a. Riffle areas usually have a greater variety of species, but pools may have more individuals of a few species.
   b. Discuss the environmental conditions in the two habitats: current; scouring action in riffles and sedimentation in pools; aeration of water in riffles; depth; light; plant material to feed upon; solidness of the bottom to support animals.
   c. Compare the adaptations of the riffle organisms with those found in pools.
4. Comparison of polluted with clean stream.
   a. Polluted streams are usually odoriferous and somewhat turbid.
   b. Fewer kinds of animals can live in polluted areas, but they may be very abundant. Usually sludge worms and "blood worms" are the principal forms.
   c. In general, absence of pure water species is a better indicator of pollution than is the presence of pollution tolerant species since the latter may be present wherever there is organic matter to feed upon.
5. Effects of erosion.
   a. Observe the small number of species in silted or sand covered areas. The frequent moving of sand and silt smothers many organisms.
   b. Note the productive gravel beds are covered with silt.

F. *Suggested References*

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NATURAL SCIENCE WORKSHOP

The third annual Natural Science Workshop sponsored by the Chicago Catholic Science Teachers Association, will be held from June 10 to June 22 at Camp Sagawau, in Illinois. The total cost for the two week period is $45. For further information write Science Workshop Registrar, 325 N. Park Road, LaGrange Park, Illinois.

School Homesteading

Viewpoint of the Administrator

WILLIAM FLOYD
Superintendent, West Lafayette Schools
West Lafayette, Indiana

A student and the principal look at a wild flower bed.

The authors show a Purdue professor their conservation project.

Outdoor education is both interesting and stimulating to youth. If a small plot of ground can be made available to a high school for intensive use and study in connection with courses in biology and conservation education, it is a very valuable teaching aid. It can be used to demonstrate many phases of these courses of study such as: planting trees or seeds, cultivating soil, fertilizing plants and care, protection and harvesting of flowers and fruits. If the courses lead to soil science studies, it will be possible to make school plots very valuable for soil samples, testing and treating. The study of tree, plant, flower, leaf, bark, stem and many other phases of identification becomes a reality when school land is available for use. Of course, the entire area of disease and insect control is open for study in the school that has access to land use. Other very interesting areas of study are water control, erosion control, and conservation of soil.

There is great opportunity for rich development of attitudes toward public property, toward property that does not belong to an individual and attitudes toward living plants and flowers. For once youth has developed an attitude of protection and care for plants, flowers, and the property of another person, there is a good chance of this attitude and habit being carried into later youth and adult life.

It is true that the school ownership of land is not common practice to the public schools in America, and it may not be a popular practice to invest public funds in the purchase of land for school study, experimentation and use. However, it is quite possible to build a case with much evidence to prove that a small tract of land will serve as a low cost laboratory facility for biology and conservation education. It will be property with almost undetermined length of life and property that will increase in value if given proper care.

Viewpoint of the Biology Teacher

KENNETH BUSH
Biology Instructor
West Lafayette High School

Girls work hard painting the fence.

Two students at work in biology "class."

We are fortunate in having our own outdoor laboratory located directly across the street from the school. The plot is provided by the Board of Education for use by classes as such use fits in with normal everyday school work.

To date the area is used almost exclusively by biology classes although instructors in other classes have helped with such things as construction, drawings, maps, and advice.

The area provides an opportunity for students to plan, organize and carry on many activities. They elect their own leaders, appoint committees, and get materials necessary for their selected projects.

The plot consists of about 2.8 acres. Formerly, this ground was unused and unkept. As part of a residential neighborhood, it was not a thing of beauty. Litterbugs from school and passersby did not help the problem. It was a woods in the city, filled with an assortment of debris. Our first project was to clean up the whole area. This consisted of removing papers, cans, dead trees, stumps, fallen branches and any other litter or trash.

Other projects were being carried on at the same time. Students worked with their own committees on the projects they had chosen. Trees were obtained from state nurseries and other sources. These were planted in a planned manner. Shrubs and evergreens made up most of the first plantings. Survival has been about 60 to 70 per cent. Another group of students engaged in producing both lettered and cartoon-type signs. Still another group was busy providing bird houses, bird feeders, and brush pile protection for ground animals. These brush piles are not visible from the road. This group did their own building, planning, and research into types of animals present, types of food available, and the like. Some children were interested in the identification of trees and shrubs. They tagged the plants they were able to identify and suggested certain trees and shrubs that might be added. Soil conservation methods are practiced in the area as are other types of conservation.

These primary projects plus many other smaller projects have been very productive toward changing the appearance of this plot

of ground. The classes were coordinated by a general planning committee and progress was steady even though not rapid. A feeling of pride is being built up within the school along with a spirit of competition to see if "we can do better than last year's class."

The neighbors and parents are very proud of the work done by the students. I feel that the students have developed a greater appreciation and understanding of the out-of-doors. This can provide relaxation and recreation for many of them in their later years.

A Reaction to "The Bureaucracy of Education"

WILLIAM E. BOYD
Assistant Professor of Education
St. Lawrence University
Canton, New York

In his article "The Bureaucracy of Education" in the March, 1956, issue of ABT, Dr. Harry J. Fuller roundly criticised almost all phases of education. His charges were quite serious. Some of his statements were simply not true.

The term, bureaucracy, implies a unity and degree of control which does not exist in education circles. There is no single agency which dictates certification laws. These laws are made by the individual states on the basis of legislators' recommendations of educational needs. In many cases these needs are pointed up by professors of education, school administrators, teachers' organizations, or lay groups. No state legislature is under any obligation to accept recommendations put forth by any single group.

Most states require for secondary teacher certification the completion of approximately 20 semester hours of work in professional education courses. These courses are not a haphazard collection of how to run a school newspaper, how to publish a yearbook, or any of the ridiculous extremes quoted by Dr. Fuller. These courses are, rather, designed to acquaint the prospective teacher with the function of the secondary school, its mechanical operation, and, of first importance, how to teach his subjects most effectively. Dr. Fuller makes the claim that the recommendation has been made for as much as 40 to 50 semester hours of education to be required for certification. He then goes on to decry disproportionate expansion of education requirements just as if this proposal had been universally accepted. This is not true. No one has seriously proposed that half of the college undergraduate program be devoted to *any* single subject field. Let us at least credit education professors with the intelligence to recognize that the undergraduate student should be acquainted with a variety of subject fields and that this can be accomplished only if the relative amount of time of each field is kept small.

It is claimed that education departments put too much emphasis on methodology. Of course they emphasize teaching methods. Education departments are not established to teach subject matter. Some students may occasionally be miscounseled to devote more time to teaching methods to the exclusion of some subject matter, but I suspect such cases are rare. Foolish counseling and mistaken advice are not limited to departments of education. Another example of exaggeration was the statement concerning the Arkansas experiment. Schools and departments of education have watched this experiment with great interest. They are among the first to experiment with new educational plans, often in the face of violent criticism from their more conservative academic colleagues.

Now we come to what I believe is the most serious and grossly exaggerated charge in all of Dr. Fuller's criticisms. It is implied throughout the article that schools of education, certification divisions of state education departments, and school administrators in general coerce students into returning to summer sessions for the express purpose of taking more education courses. It is quite true that if a

student intends to pursue graduate study for the purpose of becoming a school administrator, it is necessary that he pursue a number of courses in education. However, for the secondary teacher no such requirement is made. In states where a Master's degree is required, no stipulation is made that any course in education be taken on the graduate level. The student is perfectly free to do his Master's and post-Master's work in any field he chooses. If he chooses not to take academic courses don't blame the education department; find out why the student is passing up other offerings. I can testify from wide personal experience that one of the principle reasons why students take so many education courses during summer sessions is that these are the only courses available to them at this time. Again and again I have witnessed the frustration of teachers returning for summer courses who sought in vain for appropriate courses in botany, zoology, physics, chemistry, mathematics, etc. It is true that a great many of the graduate courses in the school of education are of relative little value to the classroom teacher, but these courses are not designed for the classroom teacher; they are designed for the school administrator and the person who is training to be a teacher of teachers—an educationist if you prefer.

It is claimed that education courses are easy as compared with the academic courses. Whether they are or not it is beside the point. The real point is that some of the graduate academic courses are frequently quite difficult for returning teachers because these teachers are then in direct competition with graduate majors in the field who have superior undergraduate backgrounds. Also in many cases these graduate courses, while they will expand the teacher's experience with the subject, will be of small use in teaching the subject.

This brings us to the theme of this whole matter. Articles such as Dr. Fuller's, attacking a segment of education actually harm the entire cause of education. Instead of searching out ridiculous instances which we can exaggerate into attacks upon any single subject field, let us see what constructive measures we can take to improve the entire program of teacher training. I strongly suspect that any of the critics of education courses have themselves never taken an education course. They know not of what they criticize. It is always easy for us to scoff at the other fellow's subjects, we have all been guilty of this at one time or another. The real need is not to diminish the size or scope of the education department or any other department; it is to foster cooperation among all of the various departments of the university in an attempt to turn out the best qualified teachers possible. In this task the academic departments have a large responsibility, one that they have not fully recognized in the past.

If we want teachers better qualified in subject matter let us examine our offerings for possible improvement and greater contribution to teaching skills. Since, in spite of methods courses, many beginning teachers persist in teaching as they have been taught, it is incumbent upon academic professors to exhibit the most effective and inspirational teaching they can.

Survey of State Programs In Conservation and Resource-use Education Undertaken at University Of Michigan

A survey is now underway of how each state is organized to give leadership in conservation and resource-use education.

The study is directed by Dr. Richard L. Weaver, Associate Professor of Conservation in the School of Natural Resources, at the University of Michigan on a research grant by the Horace H. Rackham School of Graduate Studies.

Each state agency concerned with education about resources will be asked to complete an inventory statement covering such things as leadership, state committees, program, financing, publications, cooperation, legislation and problems or obstacles to progress.

The results of the inventory will be used by Dr. Weaver in scheduling visits to each of the states to interview the key individuals responsible for the programs.

It is anticipated that the results of the study will help guide professional organizations and foundations in their efforts to be of greater service nationally.

Inexpensive Exhibits for Biology Teachers

JOSEPH L. PARKHURST, JR.
Preparator, Colonia, New Jersey

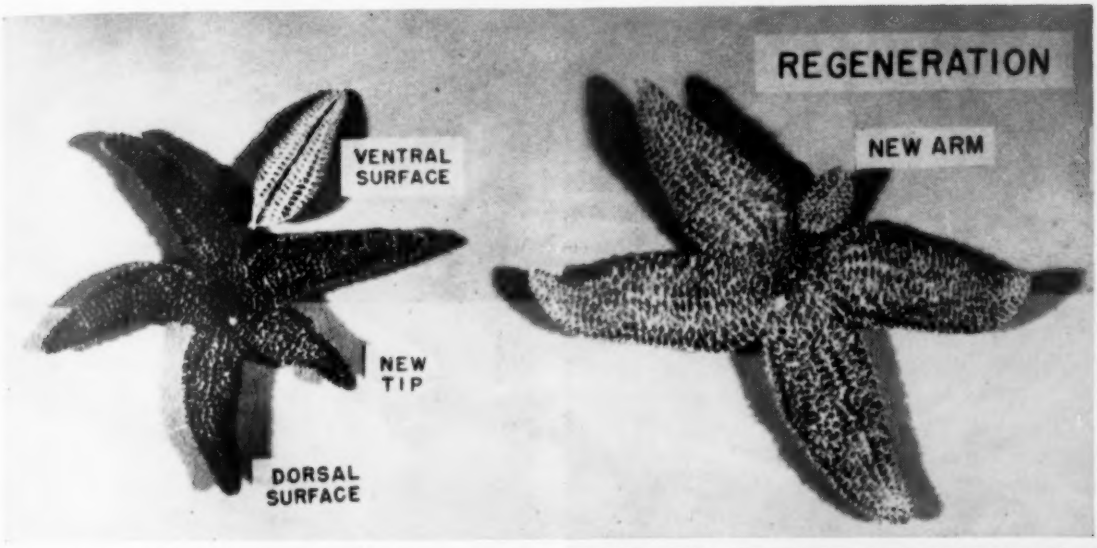

FIGURE 1. Portion of Asterias panel showing labels.

Biology teachers can produce their own exhibits on many botanical and zoological topics. Within a short time these simple panel exhibits will become a nucleus around which a school museum might be developed. In this space panels on seashore animals and trees will be discussed.

Your projected group of panels should have uniform dimensions, such as 18″ x 24″ or 16″ x 20″. A lumber yard will sell you 4′ x 8′ sheets of Upson board 3/16″ in thickness, cut your panels from this sheet and put wood frames on them. Frames will protect and support the board. The price for the whole operation should not cost you more than $2.00 per panel.

A hardware store can supply cement, paint, turpentine and brushes. For cementing specimens you can use Weldwood contact cement, but Duco is suggested for letters.

Raised cardboard letters must be secured from an artist's supply house. They are available in several sizes and colors, but you will probably find 3/4″ white letters satisfactory. Boxed letters may be bought from Joseph

FIGURE 2. Tree Seeds.

FIGURE 3. Limulus.

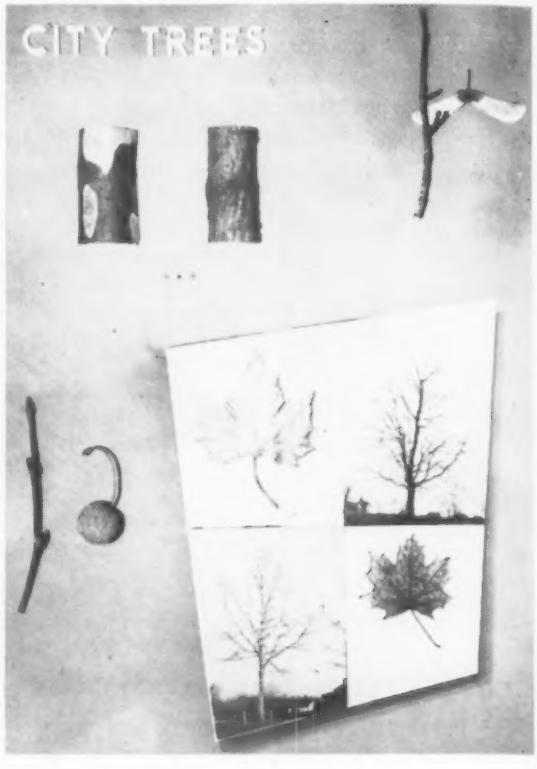

FIGURE 4. City Trees.

Mayer, Union Square, New York. Smaller labels may be typed or printed (Figure 1).

Use flat alkyd enamel on panels. If you are going to put on a line drawing for background (Figure 2) you should make the sketch on paper first and then trace it on with carbon paper. A very small brush is necessary. A color that will show up clearly against the background should be used.

In some cases you might want to mount an enlarged photograph as background (Figure 3). Photo-finishers will charge approximately $1.00 for an 8" x 10" dull print and $2.00 for 11" x 14". Apply Weldwood cement to the back of your enlargement, place on the unpainted panel and press firmly with a book. If you work fast and carefully you should have a good bond.

After background is ready you can mount your dry specimens as desired. By making slight gouges into the panel board with a penknife where larger specimens go you will assure strong mounts. Only light material should be mounted on upright exhibits. With a ruler to help you letters may be cemented easily.

If a key is needed you can use a black and white outline. It may be placed next to your panel with text, or pertinent information, typed. If necessary it may be photographed and enlarged.

Marine specimens can be purchased from a supply house if you are not located within reach of the shore. Contact the Marine Biological Laboratory at Woods Hole, Massachusetts. You might ask museums for extras or have students bring back specimens from vacations.

It is advisable to use dried material when mounting fragile items, such as crabs. Cast shells are too brittle. To restore some faded specimens you can use water colors while following a guide book. The sponge, starfish and crab can be colored with flat enamel.

For panels on trees (Figure 4) you can obtain seeds, leaves, twigs and wood in your own neighborhood. Wood samples showing bark, grain and cross-section may be cut on a

FIGURE 5. Portion of White Oak panel showing germination.

power saw. These should be about 1/2" in thickness for mounting purposes.

Winter and summer views of trees can be mounted in photographic form. Oak germination stages (Figure 5) may be dried for mounting, but many must be photographed. You can grow germination stages, mount and photograph them. If desired you can collect and prepare leaf litter for background.

You will probably have some good ideas of your own for exhibit making. Others will come up as you go along. Exhibits do not have to be expensive if you use what you have around the school and neighborhood. This rough outline may prove helpful to you, as well as stir up interest with your students.

The third annual Nature Camp will be held June 25 through August 18, 1956. Tuition is free to Illinois residents. For further information write Chicago Teachers College, 6800 South Stewart Avenue, Chicago 21, Illinois.

Traffic Victims In the Laboratory

DONALD LAMARE
Bethesda-Chevy Chase High School
Bethesda, Maryland

During the last three years I have picked up many dead animals along the edge of various important highways near Washington, D. C. These animals, killed by automobiles, proved very useful in the laboratory.

Raccoons and opossums showed stomach contents of bird feathers, corn, cabbage, and other greens. It was a good demonstration of their omnivorous habits. Grey squirrels showed finely chewed mast as their autumn diet. A red-tailed hawk's stomach had in it the legs of a grey squirrel.

I have used about a dozen opossums in the laboratory, and only two failed to show parasitic worms in the stomach and intestine. Luckily, these opossums were available when we were studying worms. Students, duly cautioned to bring in only dead animals fresh in appearance and not badly mangled, contributed several times to this part of our program.

I feel that the availability of these wild animals for dissection-demonstrations added much to our laboratory studies.

Microbiology Institute

The Ninth Annual Industrial Microbiology Institute will be held at Purdue University, June 4-9. Sponsored by Purdue's Department of Biological Sciences and Division of Adult Education, this short course has two main features. First, daily classes in which the student will learn to recognize and identify industrially important fungi. Second, evening lectures presented by visiting scientists will give the student a sound, up-to-date view into the various fields of industrial microbiology. This year, speakers from the fields of industrial fermentations, paper industries and antibiotics in food preservation will be present.

For further information write to the Institute's director, Dr. C. L. Porter, Department of Biological Sciences, Purdue University, West Lafayette, Indiana.

Woods Hole Diary

ROBERTA EIKE
Graduate Student
Radcliffe College

Every summer a number of courses of instruction in biology are presented at the Marine Biological Laboratory at Woods Hole, Massachusetts. During the first six weeks courses in embryology, physiology, and marine botany are offered, while those in marine ecology and invertebrate zoology are given during the last half of the summer. The student body consists of undergraduate and graduate students from all over the United States, while some of the finest professors from this country and abroad are included among the instructors. Congruent with the regular class lectures, field trips, and laboratory experiments are a series of seminars in which leading scientists present the results of their research, much of which is carried out at the Marine Biological Laboratory itself.

Facilities for study and lodging include a library which is open twenty-four hours a day, lecture rooms, laboratories equipped with fresh running sea water for the maintenance of living marine plants and animals, several furnished dormitories and appartment buildings, and the mess hall, in addition to boat houses, carpenter and machine shops, and the various supply departments necessary for maintaining active instruction and research in the biological sciences.

The benefits derived from the close association of students with scientists are enormous, not only in the aquisition of firsthand information but in the enthusiasm for a broadened awareness of the total implications of original research, and can be fully appreciated only by those who have actually had such an experience. The following are typical excerpts from a diary kept throughout the duration of the course in Marine Ecology.

Monday, July 26: The Cape Codder from New York arrived in time for us to register, then dine at the "Mess" before our first lecture at 8:00 P.M. Dr. Bostwick Ketchum of the Oceanographic Institution, who is in charge of the Marine Ecology course, started us out with the first of his lectures on the environmental phases of ecology. During the coming weeks we will study the various marine habitats and their life, including the phytoplankton, zooplankton, macroscopic algae, and benthic animals.

Tuesday, July 27: Over at Rockefeller Building our botany instructor, Dr. Moul, lectured on the phytoplankton, illustrating them with projected slides of diatoms and dinoflagellates. At our laboratory tables in the next room we spent the day identifying and drawing some of the species common at Woods Hole this time of year. The regular Tuesday night seminar was on the physiology of *Chlamydomonas*.

Wednesday, July 28: It's a beautiful sunny day! The breeze is always blowing here, so it never gets too warm. We went on a field trip aboard the "Arbacia" out into Vineyard Sound and Buzzard's Bay, taking phytoplankton tows and Secchi disk readings for measurement of population at three different stations, along with water and air temperatures and water samples for determination of dissolved oxygen and water and air temperatures. Later we will correlate population counts of the dominant species with this environmental data. At noon we ate the lunch packed for us and tried to identify some of the gulls cruising overhead. Tonight Dr. Alfred Redfield is giving the first of the weekly ecology seminars.

Monday, August 2: This afternoon we observed the zonation on a vertical transect of rock at Nobska Point, then scraped and scrubbed it clean so that we can watch the succession of returning organisms during the next few weeks.

Wednesday, August 4: We had our first lecture today by Dr. Jenner, who is teaching the zoological part of the course. In the laboratory we're growing *Nitzschia closterium* in flasks containing various combinations of mineral nutrients, making a series of counts in order to determine the rate of growth and maximum population attained in each, but this afternoon Dr. Moul figuratively kicked us out for a swim at Nobska Beach. At the ecology seminar this evening Steeman Nielson presented a lecture on the Phytoplankton. Afterwards Mike, the assistant, had hot coffee, tea, and cookies ready

Collecting the macroscopic algae or "kelp" at the rock jetty near Sandwich, Cape Cod.

as usual for the discussion period back at Rockefeller.

Monday, August 9: Went to a lecture and discussion concerning "The Scattering Layers of the Sea" at the Oceanographic Institution tonight. It was so interesting! They think the sonar echos reflected from the vertically migrating "ocean bottom" may be caused by Euphausiids, fish, squid, or some other marine organisms and are trying to devise a net or camera that will show definitely what they are.

Tuesday, August 10: Today again we went out on the "Arbacia," this time to make zooplankton tows. Back in the laboratory under the binocular microscope they represented an array of undersea carnival characters, their bold costumes vying for admiration with the more subtle hues of the sunsets. There were minute, transparent, jet-propelled, baby squid colliding with the sides of the depression slide, their red, green, orange, and brown chromatophores all the while contracting to polka dots then exploding out into diffuse blotches of color; a brilliant orange marine annelid, its tentacles gently probing, parapodia undulating in unbroken lateral ripples as it glided over the substratum; and jewel-like copepods with ruby eyes gleaming like tiny flares as their emerald backs flashed across the field.

Measuring the flow of a stream into Great Pond.

Observing the Zonation of Sedges at Great Pond.

Wednesday, August 11: The seminar tonight was by Dr. Raymont on the "Physiology of the Zooplankton." Afterwards we showed Dr. George Clark from Harvard the *Pinilia* in our tows, the abundance of the cladoceran this far north being indicative of a warmer climatic change.

Monday, August 16: This morning we drove up to Sandwich where we saw pink sea anemones and starfish stranded in the jetty's rocky pools as the tide went out. Here the cold Labrador Current is trapped in the hook formed by Cape Cod, offering an ideal habitat for the macroscopic algae. Diving with face masks in the icy water we could see creeping blood starfish and iridescent *Chondrus crispus* clinging to the walls of rocky crevices, while from tenacious holds on the bottom undulated upwards the broad, leathery kelp.

Wednesday, August 18: We're doing physiological experiments on the endurance of algae from different depths to heat, dessication, and extreme salinity changes. Tonight

Examining fresh water Crustacia with a hand lens—Great Pond.

we heard a lecture on the "Ecology of the Salmon."

Sunday, August 22: Peggy and I borrowed a stone chisel and hammer from Mr. Hilton, the carpenter, a pack from Ken, and with doubtful glances and best wishes from Bob, Marius, Mike, Dave, and Oscar took the ferry to Martha's Vineyard where we hitch-hiked the twenty miles to Gay Head to search for fossils. Having acquired the mold of a portion of *Equisetum* stem, a petrified seed and whale vertebra, and more carbonized leaves and stems imbedded in iron pyrites nodules than we could stagger back under, we did just that.

Monday, August 23: Today we went to Great Pond where we counted the benthic animals on a horizontal transect of an estuary, took plankton tows and the inevitable oxygen samples, measured the rate of flow into the pond, and observed the zonation of plants from the water's edge back to the shrubs and trees. Tonight Peggy, Bill, Dick, and I are going to see "Mr. Roberts" at the Falmouth playhouse.

Tuesday, August 24: Mr. Harry Turner from Oceanographic gave us a lecture on the ecology of the oyster. Tomorrow we're going to Barnstable to study the tidal mud flat biome. C. Evelyn Hutchison is giving tonight's seminar, his topic being the "Invasion of Fresh Water by the Seas."

Thursday, August 26: We are submitting three species of snails to experiments similar to those carried out on the algae. Just as their zonation indicates, the high *Littorina litorea* can withstand greater environmental variations than can its lower- zoned relatives *L. saxatilis* and *L. obtusata.*

Monday, August 30: It was a perfect day for our class picnic! The sun and sand sparkled at Tarpaulin Cove where we spent the day swimming, beachcombing, and stuffing ourselves on lobster and steamed clams. The unforgettable, spray-drenched, homeward trip to final dock in quiet Eel Pond was the fun-filled culmination of a happy, enlightening summer.

Tuesday, August 31: Hurrican Carole struck Woods Hole in its devastating flight up the New England coast leaving the little Marine Biological Laboratory, too, a shambles of shattered and flooded equipment.

Wednesday, September 1: Sadly, one day prematurely, we concluded our experiments, compared the results, then left early-autumed Woods Hole to its inhabitants' long winter task of restoration.

CONFERENCE ON THE IMPROVEMENT OF BIOLOGY TEACHING

PLAN CONFERENCE — Preparations are made for a conference on the improvement of the teaching of biology which was held at the Lorado Taft Field Campus of Northern Illinois State Teachers College in mid-April. Planning on the details for the conference are left to right, Robert Bullington, who was chairman of the conference, Art Baker, of Crystal Lake, past president of the National Association of Biology Teachers and Robert Smith, chairman of the membership group of the National Association of Biology Teachers. These three men were discussion leaders.

The Balance of Nature?

RICHARD T. WAREHAM
Head, Science Department
D. C. Heath and Company

Conservationists and the biologists would do well to rid themselves of phrases such as "balance of Nature" and "Nature's balance."

These phrases always carry the implication that, but for man's interference in one way or another, there is stability of plant and animal populations in kind and number. Evidence from every kind of careful, long-range investigation shows that in any area with or without interference by man, population and kinds of both plants and animals, including man, fluctuate. *Constant change, not stability, is the rule.* Fluctuations are slow or rapid, depending upon such factors as the size of the area considered, the incidence of catastrophes such as windstorms, fire, and floods, and the relative mobility and life span of the species considered.

The phrases usually imply that man is *not part of nature*, indeed they imply a man *vs.* nature concept. This is contrary to evidence from comparative physiology, anatomy, embryology, and paleontology and to evolutionary theory.

Except in complexity and speed, man's activities are strictly comparable to the activities of other animals.

Man destroys part of a forest and builds a city.

Prairie dogs destroy part of a prairie and build a "city."

Man builds roads, destroying the vegetation in the way.

Deer make trails, destroying vegetation they step on.

Man replaces forest and prairie with corn, wheat, oats, and soybeans.

Squirrels, albeit unwittingly, replace prairie with hickory and oak.

The parallels can be extended. The conclusion is inescapable that man is *part of nature*—just as much a part as are the pheasants (introduced to America from Europe by man), or the bison (which evolved on this continent), or the occasional South American species of algae found in North American waters (presumably introduced on the feet of migrating waterfowl).

It would seem more reasonable to base conservation teaching, not on the hypothetical and nondemonstrated "balance in Nature," but on demonstrated interrelationships among living things, on the ultimate dependence of all living things on a favorable nonliving physical environment, on the role of living things (including man) in maintaining that environment, and finally on the concept (neglecting theology) that only what is good for man is "good." Why mourn the passing of the Heath Hen, the Passenger Pigeon, and Dodo? One may just as well mourn the passing of the dinosaurs! And by the way, who or what upset the "balance of Nature" that existed then?

Surely, it is most important to teach that if man is to continue to survive, he must ensure his food supply, and that his food supply is primarily dependent upon (in our present practice) fertile soil (topsoil), which must contain certain essential minerals and enough water to make up that lost in evaporation from the soil itself and in transpiration. To keep that fertile soil and the additional water needed for industrial processes and the many other needs of civilized man, we must, it seems to have been clearly demonstrated, hold erosion to the rate that topsoil is produced from parent materials, and we must protect watersheds to prevent rapid runoff. Incidentally, the not-to-be-minimized advantages of recreational areas, game mammals, birds, and fish, insect-eating song birds, etc., will accrue.

The Camp Unit of the New York State Employment Service states that there are still many desirable summer camp jobs for both general counselors and specialists. For further information write or apply in person to Camp Unit, 119 Fifth Avenue, New York.

Biology for a General Education Program In Teacher Training

FREDERICK A. MEIER, President
Teachers College
Salem, Massachusetts

For the past year or more the writer has attended many educational meetings concerned with general education. The discussions have dealt with general education for teacher education and a general-education-type course in biology for teachers colleges. The opinions expressed, the terminology used, and even the definition of terms at times showed little agreement.

It seems apparent that in the problem of general education we must start with some basic assumptions:

1. The courses in the general education program should be different from the sequential or "first" courses. That is, a general education course in biology should be different from the primary course in biology leading to a series of courses in the same field.
2. A course in general biology is a necessary phase of teacher education.

Therefore our problem becomes one of selecting content for this general-education-type biology course.

As standard points of reference may the writer point out that there are some constants in the selection of this material. Let us state the constants. The course content should be selected so as to develop in the student knowledge and appreciation of the scientific attitude and understanding and use of the scientific method. Lecture periods should devote more time to life problems having to do with current human relations. Individual and small group laboratory experiments and experiences should be provided. For example, blood typing and the many social problems connected with it may be used as the hub of many individual and group activities in the laboratory. Movies and visual aids are valuable assets, but they must be used with care and planning.

Because the general-education-type course in biology will influence the life of the student in many ways he needs to know both the method of science and the material of biology. He will use the knowledge in teaching his future pupils as well as in solving the problems of life. In other words, the student needs an intelligent appreciation of biology even as he needs an appreciation of music, art or the democratic process. The order inherent in biology, the manner in which it lends itself to the guidance of learning, and the degree of difficulty it possesses are only a few of the naturally great advantages that a course in biology can contribute to the general-education program. Those of us who are concerned with this type of biology course should hold the teaching of basic facts and principles as a major objective. The subject should be presented as a science of universal interest and its mastery as an intellectual achievement of some magnitude.

Assuming agreement on the constants and the underlying purpose of the course, let us consider some topics purposely selected for a general-education-type course in biology. May the author interject at this time the opinion that this course by special reading, student research, and individual laboratory work can benefit the student in the teachers college who wishes to make biology an area of concentration. It is recommended that the course be given for six credits, two lecture periods and one double laboratory period per week for two semesters.

Some of the major areas which should be covered are the scope and history of biology, general classification, and the relation of biology to health and culture. The instructor may include comparisons of plants and animals as well as chemical concepts dealing with matter and energy. The process of diges-

tion can be studied along with such topics as foods, diet, metabolism, photosynthesis and the physiological effects of alcohol and tobacco.

Unicellular organisms may be studied in connection with their effect upon health and their commercial importance. Animals and their response to environment may be studied in relation to their structure and function, along with the operation of the organ systems.

The vital processes of plants and animals may be studied in connection with their fundamental relationships to each other.

The teacher of biology can develop a course from the selection and emphasis of these and other basic concepts. By so doing, he may insure from the general-education-type course a presentation of the interrelationship of plants and animals and the many problems they present to the welfare of man.

In summary it would appear that many changes and some progress have been made in courses geared to the general-education program. Courses in science, biology in particular, must go along with these changes and adapt themselves to the new program. Examination of our present needs in teacher education and of basic objectives in biology suggests to us the direction in which these courses should be strengthened and modified. Reflective thinking along these lines leads to the following conclusions: rigorous and scholarly teaching of facts and principles of biology should not be omitted; the understanding of biology must be presented as an intellectual achievement of the mastery of an exact science; biology must be presented in its proper relationship to the world around us and not as isolated bits of knowledge; the cultural, economic, and humanitarian aspects of the science should be emphasized. In this way, we may insure ourselves against the dilution of a great science and at the same time take advantage of the wonderful teaching climate it affords.

Books for Biologists

THE UNLEASHING OF EVOLUTIONARY THOUGHT. Riddle, Oscar. Vantage Press, Inc., New York 1, New York, 430 pp. 1956, $4.50.

Just received at press time. See comments by several scientists in ad on p. 202 of this issue.

Cooperative Committee Meeting

BROTHER G. NICHOLAS, F.S.C.
La Salle High School
Cumberland, Maryland

The Spring meeting of the Cooperative Committee of the Teaching of Science and Mathematics of the American Association for the Advancement of Science was held March 2 and 3, 1956 at the Rackham Graduate School of the University of Michigan, Ann Arbor, Michigan. The author was chosen by President John P. Harrold to represent the NABT at these meetings for the coming year, succeeding Prevo Whitaker. The NABT has an important stake in these meetings since much of the work of the committee is devoted to improving science teaching, particularly in such fields as high school biology, nature classes, teacher training groups, etc.

John Mayor, Director of the Science Teaching Improvement Program, gave a summary of STIP and announced that I. E. Wallen of Oklahoma A. and M. has been appointed assistant director. Representation of scientists on Teacher-Certification commissions is being sought. Some State Academies of Science are cooperating in securing appointments of scientists to these commissions. Grants have been approved for the University of Oregon, the University of Nebraska, the University of Texas, and Pennsylvania State University for the study on the use of science counselors.

To encourage proficiency in the field of science teaching and a desire to increase the prestige of the high school science teachers a request has been made to the AAAS for funds to present annual awards to outstanding secondary school science and mathematics teachers. It is also hoped that representatives of tax-supported Women's Colleges will take a more active part in the recruitment of science teachers. Plans for increased use of television, investigation of working conditions of teachers and proposals to establish Saturday lectures at different colleges were also studied.

Other items of business that were discussed at some length included the Smith-Hughes

(Continued on next page)

COOPERATIVE COMMITTEE

(Continued from page 201)

Act, dealing with Federal legislation for agricultural and home economics education. A committee was appointed to study the feasibility of a similar bill for support of organized science teaching. The matter of science teaching at the elementary school level and its effects on the secondary school science courses was mentioned. It was noted that possibly the elementary school teacher's reluctance to discuss science might have an adverse effect on the student. Programs dealing with improvement of elementary school science have been organized by NSTA and ANSS. These will be studied so as not to duplicate activities of these societies.

The development of entirely new courses in science at the intermediate college level was called for to remedy the deficiencies in the preparation of inservice science teachers. A strategy committee was appointed to plan a program for attacking the problem of proper undergraduate training for the science teacher and it was urged that membership of this committee include some "pure" scientists as well as science educators. Some states impose upper limits on the number of credits acceptable in the field of specialization of the teacher although several states are currently considering an increase in the requirements of specialization. Unfortunately other states want to increase the requirements in professional education to the detriment of the field of specialization.

A proposal has been made to the AAAS Board of Directors for a series of 26 television films designed to educate the public on the aims of science and the kinds of people that scientists are. Funds have been promised by the Fund for the Advancement of Science to aid plans of the NRC Committee on Educational policies for the production of teaching films in the field of biology. Harvey Sorum reported on the University of Wisconsin's

(Continued on next page)

THE UNLEASHING OF EVOLUTIONARY THOUGHT

by Dr. Oscar Riddle

The source of current anti-intellectualism in modern society and of pervasive curbs on freedom to teach—to teach biological thought and insight concerning ourselves, in particular—are here made the theme of broad and well-documented inquiry by an eminent biologist. This unique study candidly explores the extent to which past and present teachings of the organized religions of the world, more especially in the United States, now suppress or denature socially vital evolutionary thought in our schools, news sources, theatre, public law, and private life.

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—*Prof. Anton J. Carlson,* University of Chicago

"Readers may come away from this study with a different understanding of themselves, and of many social problems that are being discussed widely but often with too little knowledge."
—*Family Life*

"No similar book has appeared in America . . . . It may well prove a history-making book."
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COOPERATIVE COMMITTEE

(Continued from page 202)

program supported by the NSF under which 50 high school teachers will spend an academic year in graduate study in science. Along with tuition and travel, a stipend is allowed for each dependent so that a teacher's family will be supported while he is studying.

At the conclusion of the meeting Dr. J. W. Buchta of the University of Minnesota was unanimously re-elected as chairman and Dr. Harvey Sorum was elected vice-chairman. Dr. Bernard Watson of the Operations Research Office at Johns Hopkins University continues as secretary. The next meeting of the Cooperative Committee will be held in Washington in October.

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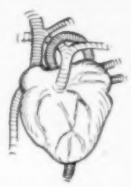

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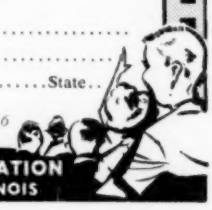

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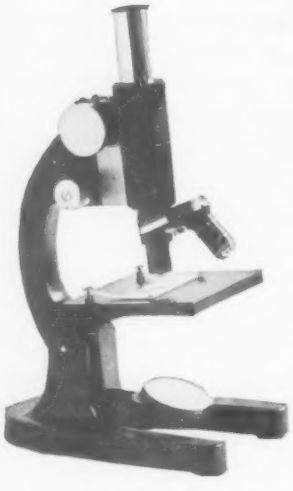

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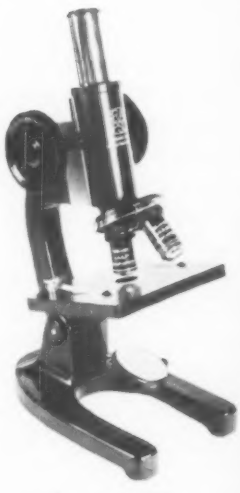

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